



Original communication

Trauma deaths outside the hospital: Uncovering the typology in Kenyan capital



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ABSTRACT

Background: Immediate trauma fatality is not amenable to trauma care and primary prevention is the key. The published profiles of deaths due to trauma differ in different regions. Injury mortality rates are higher in developing countries where injury data capture systems are unreliable for prevention purposes. **Objective:** To describe the pattern of pre-hospital injury (immediate) deaths at the Nairobi city mortuary and compare these with hospital (late) trauma deaths.

Methods: Consecutive trauma autopsies performed over one year (November 2009 to December 2010) at the main mortuary of the Nairobi city council were analyzed for demographic (age, sex, occupation) characteristics, circumstances of the trauma and injury patterns. The patterns of injuries were compared to those of victims who survived and later died at the Kenyatta National Hospital over the same period. **Results:** Two hundred and thirty seven trauma autopsies were analyzed. The average age of the victims was 29.8 years (range 1–67 years). Christians (93.7%) and males (89.5%) predominated. The place of injury was the road in 32.9% and home/neighborhood in 57.5% of cases. The main mechanisms of fatal injury were traffic (35.4%), gunshot wounds (25.7%) and assault (19.8%). Burns and suicides accounted for 5.9% and 6.3% of fatalities. Most fatalities were intentional (59.4%) Of vehicular injuries, pedestrians predominated (65.5%). For assault, blunt and penetrating injuries accounted for 68.7% and 31.1% of fatalities. Law enforcement officers were responsible for majority of gunshot deaths. Fatal injuries were sustained in single, two and multiple regions in 56.2%, 25.7% and 14.2% of cases. The body region most involved was the head/neck (40.5%). Twelve children under 15 years died. Compared to in-hospital deaths, pre-hospital deaths were associated with intentional injuries, night-time occurrence and preponderance of gun involvement.

Conclusion: Injury was a significant cause of mortality among adults of working age in this urban African setting. Intentional injuries predominate in causation of immediate but not late deaths. Local prevention programs should incorporate mortuary data to unravel further aspects of trauma and address violence as a key determinant of prehospital mortality.

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1. Introduction

The post injury care of trauma victims has improved with developments of trauma centers and advances in trauma life support and critical care. Immediate trauma deaths are less amenable to this improved trauma care and primary prevention remains a key strategy to address trauma deaths outside hospitals.¹ The

published profiles of immediate deaths due to trauma differ in different regions. Whereas prevention has been successful in high income countries where regional and national resources for injury programs are available, low income countries struggle to mount injury prevention programs despite higher rates of homicide, suicide and war-related deaths.²

For prevention of violence, the vulnerable populations could be targeted in social enrichment programs² while for road trauma deaths, addressing avoidable human behavior responsible for 85% of “accidents”³ as well strategies in road/vehicle engineering, education and law enforcement may succeed.⁴ This success relies on good trauma data. Records indicate that the burden of trauma in

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Kenya is increasing³ but no comprehensive data collection mechanism exists.

This study analyses immediate injury deaths as recorded in a large Nairobi mortuary over one year and compares the results with in-hospital deaths (late deaths) at the city's main hospital over the same study period.

2. Methods

The Nairobi City council mortuary is the largest public mortuary facility in Kenya. It receives all pre-hospital deaths in the city. There is no formal trauma records system in the facility and a data sheet was created specifically to capture the data reported in this study. Although post mortems are mandatory for all pre-hospital deaths, the recording of the procedures is unreliable. The study engaged a site pathologist (PO) to coordinate the autopsy conduct and recording for this analysis.

Across a road from the city mortuary is the Kenyatta National Hospital (KNH), a large public referral hospital which also serves as the teaching hospital for the University of Nairobi. The hospital receives most of trauma occurring in the city and its environs. Admissions due to injury are usually disposed to the hospital's various wards or the intensive care unit. Deaths on arrival at the hospital are referred to the KNH mortuary.

The study population included trauma autopsies performed at the city mortuary and all deaths occurring after admission to the hospital between November 2009 and December 2010. Excluded were deaths due to poisoning, overdose or foreign body aspiration. The following information was abstracted: age, gender, intent of injury, mechanism of trauma (vehicular, violence, gunshot, burns, asphyxia) and anatomical regions injured. The results were compared to a subset of patients who died after admission for trauma at the KNH. Deaths at the city mortuary were denoted immediate while those at the KNH were late deaths.

Approval for the study was granted by the Kenyatta National Hospital-University of Nairobi ERC. Data are presented in form of charts and tables.

3. Results

Two hundred and thirty seven autopsies of trauma related fatalities were included. Most victims (89.5%) were males (ratio 1: 18). The mean age at death was 29.8 (SD 12.2) years. The most common age group involved were victims in their third decade

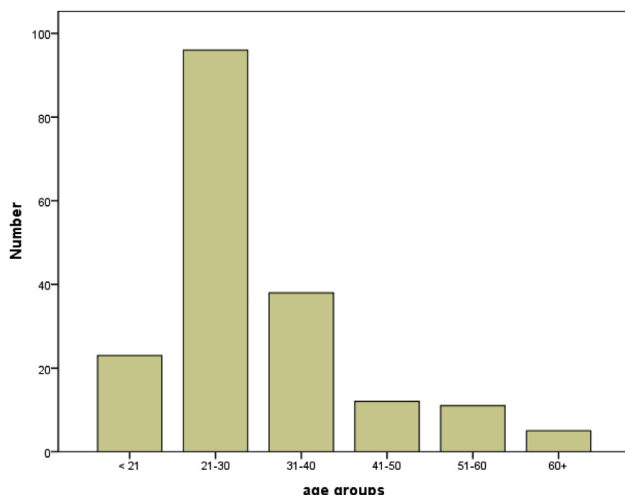


Fig. 1. Age distribution of trauma fatalities at Nairobi city mortuary.

Table 1
Demographic characteristic of injury fatalities at the Nairobi city mortuary.

Variable		Number	Percentage
Gender	Male	212	89.5
	Female	25	10.5
Intent	Unintentional	95	40.6
	Intentional	139	59.4
	Self-inflicted		
Religion	Christian	222	93.7
	Muslim	12	5.1
	Other	3	1.3
Race	Black	234	98.7
	Asian	3	1.3
Scene	Road or street	95	40.1
	Home	52	21.9
	Neighborhood	86	36.3
	Other	4	1.7

(Fig. 1). The proportions of deaths due to intentional and unintentional injuries were 59.8% and 40.2% respectively (Table 1).

The most common mechanism leading to injury death was violence (Fig. 2). Specific mechanisms included traffic 35.4%, gunshot 25.7%, assault 19.8%, self-inflicted 6.3%, burns 5.9%, falls 1.7% and other 5.1%. Pedestrians accounted for two thirds (65.5%) of traffic injury-related deaths, blunt mechanism accounted for 68.9% of assault cases while majority of deaths (76.2%) due to gunshot injuries were caused by law enforcement officers police (the rest by robber 9.3%, carjacker 3.2%, other/unknown 11.1%).

The relative contribution of the mechanisms differed for both males and females. A bigger proportion of females were affected by traffic (48% versus 34%), fall (4% versus 1.4%) and burn (26% versus 4.7%) deaths. While no female died as a result gun trauma, about one third (28.8%) of male deaths were due to gunshot injuries (Table 2 and 3).

Forty three (54.4%) traffic deaths occurred during the day. The time of incident was not recorded for eight victims. Sixty seven (73%) out of ninety two assault and gunshot deaths occurred at night.

With regards to the regional distribution of the injuries, victims sustained injuries to one anatomical region, two regions, three regions and more than three regions in 56.2%, 29.7%, 10.5% and 3.4% of cases respectively (Fig. 3). The head was injured in 72.1% of cases (isolated in 40.5% of victims, in combination with injuries to chest/abdomen in 29.1%, with associated extremity injury in 2.5%). The chest and abdomen were involved, isolated or in association with other injuries, in 21.7% of cases.

Majority of the victims of isolated head trauma were due to assault (37.1%) and traffic trauma (30.3%). Most of victims of chest trauma were due to gunshots (63.2%) while those with abdominal trauma were due to traffic ((44.4% and 33.3%), (Table 4)).

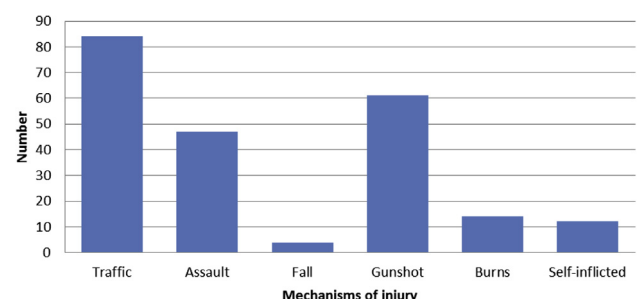


Fig. 2. Mechanisms of injury for trauma related deaths at Nairobi city mortuary.

Table 2
Mechanism of injury by gender of victim.

Gender	Traffic (%)	Assault (%)	GSW (%)	Fall (%)	Burns (%)	Suicide (%)	Other (%)
Male	72 (34)	42 (19.8)	61 (28.8)	3 (1.4)	10 (4.7)	13 (6.1)	11 (5.2)
Female	12 (48)	5 (20)	0 (0)	1 (4)	4 (16)	2 (8)	12 (5.2)

Traffic trauma was the leading cause of death in all age groups except victims 41–50 years of age whose predominant cause of death was assault (Table 5).

Compared to 121 hospital trauma fatalities, deaths captured at the mortuary were more intentional (59.4% versus 26.7%), and involved more cases of gunshot mortalities (25.7% versus 7.5%). Whereas 71% of hospital trauma deaths were due to day time injury events, the proportion was half this for pre-hospital deaths (Table 6).

4. Discussion

This study has documented the pattern of immediate trauma deaths at Nairobi's main mortuary. The data presented excluded deaths at other mortuaries. From this analysis however, the predominant and significant causes of deaths are highlighted to which efforts for prevention of the injuries should be prioritized. The large proportion (79%) of persons of working age (20–50 years) reveals the potential enormous economic consequences.⁵ Although restricted to a single center approach, Nairobi is home to most of the country's vehicular units and 'accidents'⁶ and increasing crime. The results can be projected to other urban centers and processed to inform a more nationwide policy. In South Africa, Injury prevention practitioners have successfully reoriented their targets to a point where injury data surveillance at the regional/city level contributes to the larger agenda of national injury prevention program.⁷

Majority of deaths were due to violence and traffic related incidents. This is consistent with published patterns from the continent, albeit with subtle peculiarities. In a South Africa, homicide is a leading cause of death (44.5 percent), followed by transport-related fatalities at 34.5 percent.⁷ In Kumasi, Ghana, 88% of the deaths were related to transport.⁸ Further, whereas violence was responsible for 45.5% of deaths in the current series, only 3% of Ghanaians died as a result of violence.⁸ The results suggest that even within geographically similar areas, differences exist with regards to the epidemiology of trauma deaths. The Kumasi result on violence is

Table 3
Trauma deaths by gender, intent, mechanism and age.

Variable		Male (%)	Female (%)	Total (%)
Intent of injury	Accidental injury	80 (84.2%)	15 (15.8%)	95
	Intentional injury	129 (92.8%)	10 (7.2%)	139
Road user type	Pedestrian	47 (85.5%)	8 (14.5%)	55
	Vehicle occupant	24 (85.7%)	4 (14.3%)	28
Assault mechanism	Blunt assault	28 (90.3%)	3 (9.7%)	31
	Penetrating assault	12 (85.7%)	2 (14.3%)	14
GSW offender	Thug/robber	6 (100.0%)	0	6
	Police	48 (100.0%)	0	48
	Carjacking	1 (50.0%)	1 (50.0%)	2
	Other	2 (66.7%)	1 (33.3%)	3
	Unknown	4 (100.0%)	0	4
Age group (years)	<21	17 (73.9%)	6 (26.1)	23
	21–30	93 (96.9)	3 (3.1)	96
	31–40	38 (100.0)	0	38
	41–50	8 (66.7)	4 (33.3)	12
	51–60	9 (81.8)	2 (18.2)	11
	60+	5 (100.0)	0	

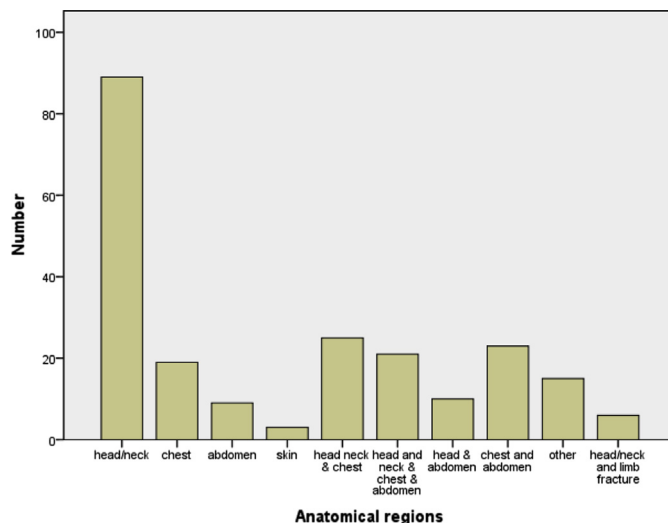


Fig. 3. Injuries sustained by anatomical regions at Nairobi city mortuary.

unexpected. Like Nairobi and the South African cities, crime levels and violence are increasing urban public health concerns in the continent making homicide a leading cause of mortality.

Self-inflicted injuries were responsible for 6.3% deaths in this series. The slightly higher rate of 9.4% in South Africa⁷ depicts a growing problem in some parts of the continent. The likelihood of underreporting is however real, as the stigma associated with deaths due to suicide and other self-inflicted trauma may make people conceal this etiology.⁸ In the Ghana account for example, no explicit self-inflicted cause was reported from the 1857 mortuary records between 1996 and 1999. Deaths due to self-inflicted injuries and falls are the only two areas where developing countries do not, by a margin, eclipse the developed countries. Vehicular death rate is 22.1/100,000 for LMICs compared to 13.6/100,000 for high income countries whereas the rate of deaths due to violence is 9.6/100,000 for LMICs versus 2.8/100,000. For falls the pattern is reversed (4.0/100,000 for LMICs, 8.3 per 100,000 for developed countries) while the rates for self-inflicted injury deaths are the same (13.5 versus 13.3 per 100,000).⁴

The result depicting preponderance of male youth fatalities (peak age group 21–30 years) is consistent with a rising culture of youth gangs who extort and rob the population.⁹ Several studies have linked incidence and patterns of violence to socioeconomic environment of countries. Male behavior exposes them to hazards of roads and industry as they hustle to earn for their families. They are also most likely to take risks and be found outdoors in search of fun. It is not surprising then that the male gender outperforms the female gender when trauma death is analyzed by temporal characteristics or age.^{10,11} The peak age of 21–30 is the post-school population who may easily be lured to engage in crime and violence for survival or for the sake of it. In the GSW group, majority succumbed to shots by law enforcement officers, a pointer to the involvement in crime. According to the WHO,² the composite rate of homicide, suicide, and war-related deaths for high-income countries is 14.4 per 100,000 but higher by a factor of more than two (32.1 per 100,000) for LMICs. Further, significant income inequalities are associated with high rates of violence, even in high-income contexts. Kenya's GDP growth rate of 4.4% is not enough to create jobs for half a million young people entering the job market every year. This fuels crime and violence.

In the current study, non-traffic unintentional deaths formed a small proportion of overall causes of deaths. When analyzed by gender however, falls and burns were responsible for 6.1% of deaths

Table 4

Mechanisms of injury by anatomical regions in mortuary trauma deaths in Nairobi.

			Mechanism							Total
			Traffic	Assault	Falls	GSW	Burns	Other	Suicide	
Regions	Head/neck	Count (%)	27	33	3	12	0	0	14	89
		% Within region	30.3%	37.1%	3.4%	13.5%	.0%	.0%	15.7%	100.0%
	Chest	Count	3	3	0	12	0	1	0	19
		% Within region	15.8%	15.8%	.0%	63.2%	.0%	5.3%	.0%	100.0%
	Abdomen	Count	4	1	0	3	0	1	0	9
		% Within region	44.4%	11.1%	.0%	33.3%	.0%	11.1%	.0%	100.0%
	Skin	Count	0	0	0	0	3	0	0	3
		% Within region	.0%	.0%	.0%	.0%	100.0%	.0%	.0%	100.0%
	Head neck & chest	Count	14	4	0	7	0	0	0	25
		% Within regions	56.0%	16.0%	.0%	28.0%	.0%	.0%	.0%	100.0%
	Head and neck & chest & abdomen	Count	11	1	0	7	0	1	1	21
		% Within regions	52.4%	4.8%	.0%	33.3%	.0%	4.8%	4.8%	100.0%
	Head & abdomen	Count	6	0	0	4	0	0	0	10
		% Within regions	60.0%	.0%	.0%	40.0%	.0%	.0%	.0%	100.0%
	Chest and abdomen	Count	7	3	0	13	0	0	0	23
		% Within regions	30.4%	13.0%	.0%	56.5%	.0%	.0%	.0%	100.0%
	Other	Counts	8	0	0	2	0	5	0	15
		% Within regions	53.3%	.0%	.0%	13.3%	.0%	33.3%	.0%	100.0%
Head/neck and limb fracture	Count	4	0	1	1	0	0	0	6	
	% Within regions	66.7%	.0%	16.7%	16.7%	.0%	.0%	.0%	100.0%	
Total	Count	84	45	4	61	3	8	15	220	
	% Within regions	38.2%	20.5%	1.8%	27.7%	1.4%	3.6%	6.8%	100.0%	

Table 5

Mortality by age groups and mechanisms of injury.

Age group	Traffic (%)	Assault (%)	Falls (%)	GSW (%)	Burns (%)	Suicide	Other (%)
<20 years	10 (43.5)	4 (17.4)	0	5 (21.7)	3 (13.0)	0	1 (4.3)
21–30	30 (31.3)	20 (20.8)	1 (1.0)	30 (31.3)	4 (4.2)	7 (7.3)	4 (4.2)
31–40	14 (36.8)	9 (23.7)	0	5 (13.2)	3 (7.9)	3 (7.9)	4 (10.5)
41–50	3 (25.0)	5 (41.7)	1 (8.3)	1 (8.3)	0	2 (18.2)	2 (16.7)
51–60	4 (36.4)	3 (27.3)	0	2 (18.2)	0	2 (18.2)	0
60+	3 (60.0)	1 (20.0)	1 (20.0)	0	0	0	0
Total	64 (34.6)	42 (22.7)	3 (1.6)	43 (23.2)	10 (5.4)	12 (6.5)	11 (5.9)

in males but 20% of deaths in females. Presumably, the female over-representation is due to the 'indoor' nature of the mechanisms.

Improvements in the medical infrastructure has improved post trauma care but has had little impact on immediate trauma fatality. The classical trauma death profile by Trunkay shows three peaks –

Table 6

Comparison of hospital versus pre-hospital deaths in Nairobi, Kenya.

Variable		Prehospital death (%) N = 237	Hospital death (%) N = 121
Gender	Male	212 (89.5)	104 (87.4)
	Female	25 (10.5)	15 (12.6)
Intent of injury	Unintentional	95 (40.6)	88 (73.3)
	Intentional	139 (59.4)	32 (26.7)
Mechanism	Traffic	84 (35.4)	76 (63.3)
	Fall	4 (1.7)	11 (9.2)
	Assault	47 (19.8)	22 (18.3)
	GSW	61 (25.7)	9 (7.5)
	Burns	14 (5.9)	2 (1.7)
Age group	<21	23 (12.8)	10 (8.9)
	21–30	96 (53.3)	47 (42.9)
	31–40	38 (21.1)	23 (20.5)
	41–50	12 (6.7)	20 (17.9)
	51–60	11 (6.1)	2 (1.8)
	>60	0	10 (8.9)
Time of day	Daytime	72 (35.0)	39 (70.9)
GSW offender	Nighttime	115 (55.8)	16 (29.1)
	Robber	6 (9.5)	7 (55.6)
	Police	48 (76.2)	2 (33.3)
	Other	9 (14.3)	1 (11.1)

immediate, early and late.¹ It is emerging that the third peak is diminishing in some Western trauma centers as a result of the infrastructure improvements¹⁰ with little modification of the initial peak. Prevention therefore remains the key to addressing immediate deaths. But, effective prevention relies on accurate data on causation and associated factors. The causal pathways for trauma occurrence and deaths are complex risk factors. In Kenya the burden of trauma occurrence and deaths have increased many times.³ Often, drivers of public transport minibuses over-speed and pick passengers anywhere on the roads while pedestrians cross dangerous roads at will with little sense for traffic.¹² The latter accounted for two thirds of traffic trauma deaths in this and in previous study¹³ and represent an important focus for prevention initiatives. From injury practice perspective, other areas that need focus include driver retraining, vehicle roadworthiness and active policing to enforce drinking and speed laws. As well, the establishment of traffic safety and injury prevention lead agency to address Kenya's traffic injury burden would be welcome. A new superhighway leading out of the city is already a source of concern for the number of deaths reported.¹⁴ Pedestrian safety initiatives including pedestrian walkways, driver and occupant safety enhanced by the use of seatbelts and helmets, vehicle padding, and the improved road infrastructure, and efforts encompassing an educational component, are effective in reducing the incidence of road carnage and associated fatality.⁴

For prevention of violence, the vulnerable population could be targeted in social development programs, academic enrichment programs, mentoring initiatives, extracurricular activities, and

attempts to reduce poverty and income inequality.² The setting and approach for this should be multisectoral and multidimensional. Most deaths due to violence and a significant proportion of traffic deaths were night time events in this study. This suggests that lightening up the city at night and enhanced policing could go some way into addressing both traffic and intentional trauma deaths in the city. The police were responsible for most of the gunshot trauma deaths. Previous report shows that for late gunshot deaths, police are only responsible for 10% of mortalities.¹⁵ This police–victim relationship warrants further evaluation.

The head was injured in 68.6% of all the victims studied. This piece of information is important for informing how a regional trauma system should develop to address the injury burden. The country has less than 20 trained neurosurgeons. It is clear that the majority of head injured patients would have to be managed by other surgical personnel. Training, investigative and treatment resources for neurotrauma would have to be prioritized if the mortality due to head injury is to reduce. Making CT scanners and critical care units available to improve initial care of the injured is justified by the data.

The pattern of trauma deaths as seen at the mortuary was different from that reported from the hospital during the same study period. This reinforces the view that the surveillance of injury is best achieved through a combination of data sources. We posit that the establishment of a city-wide trauma surveillance system should encompass at the very least, hospital data and postmortem reports.

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Conflict of interest

None.

References

1. Trunkey DD. *Trauma Sci Am* 1983;**249**:28–35.
2. WHO (World Health Organization). *World report on violence and health*. Geneva: WHO; 2002a.
3. Odero W, Khayesi M, Heda PM. Road traffic injuries in Kenya: magnitude, causes and status of intervention. *Inj Control Saf Promot* 2003;**10**:53–61.
4. Mock C, Quansah R, Krishnan R, Arreola-Risa C, Rivara F. Strengthening the prevention and care of injuries worldwide. *Lancet* 2004;**363**:2172–9.
5. Osime OC, Ighedosa SU, Oludiran OO, Iribhogbe PE, Ehikhamenor E, Elusoji SO. Patterns of trauma deaths in an accident and emergency unit. *Prehospital Disaster Med* 2007;**22**(1):75–8.
6. Bachani AM, Koradia P, Herbert HK, Mogere S, Akungah D, Nyamari J, Osoro E, Maina W, Stevens KA. Road traffic injuries in Kenya: the health burden and risk factors in two districts. *Traffic Inj Prev*;13:sup1:24–30.
7. Matzoupolous R. *A profile of fatal injuries in South Africa: third annual report of the National Injury Mortality Surveillance System*. Pretoria and Cape Town, South Africa: Crime, Violence and Injury Lead Programme, University of South Africa, and South African Medical Research Council; 2002.
8. London J, Mock C, Abantanga FA, Quansah RE, Boateng KA. Using mortuary statistics in the development of an injury surveillance system in Ghana. *Bull WHO* 2002;**80**:357–64.
9. Donson H, Van Niekerk A. Suicide. In: Matzoupolous R, editor. *A profile of fatal injuries in South Africa; third annual report of the National Injury Mortality Surveillance*. Cape Town: MRC Press; 2002. p. 31–4.
10. Gunt M, Ghaemmaghani V, Gruscicki A, Urban J, Frankel H, Shafi S. Changing epidemiology of trauma deaths leads to a bimodal distribution. *Proc (Bayl Univ Med Cent)* 2010;**23**(4):340–54.
11. Soreide K, Kruger AJ, Ellingsen CL, Tjoserik KE. Pediatric trauma deaths are predominated by severe head injuries during spring and summer. *Scan J Traum Resusc Emerg Med* 2009;**17**:3.
12. Nantulya V, Muli-Musiime F. Kenya: uncovering the social determinants for road traffic accidents. In: Evans T, Whitehead M, Diderichsen F, Bhuiya A, Wirth M, editors. *Challenging inequities: from ethics to action*. Oxford: Oxford University Press; 2001.
13. Saidi HS, Macharia WM, Ating'a JEO. Outcome for hospitalized road trauma patients at a tertiary hospital in Kenya. *Eur J Trauma* 2005;**31**(4):401–6.
14. Sangira S. *Blame game over Thika superhighway deaths*. www.the-star.co.ke; May 14, 2012 [accessed 17.08.12].
15. Saidi HS, Nyakiamo J, Faya S. Gunshot injuries as seen at the Aga Khan hospital, Nairobi, Kenya. *East Afr Med J* 2002 Apr;**79**(4):188–92.